

## Building an ecologic-economic model to improve silvicultural management practices in Matang (Malaysia)

Quispe Zuniga Melissa R.<sup>1</sup>, Behara Satyanarayana<sup>2</sup>, Cyril Piou<sup>3</sup>, Uta Berger<sup>4</sup>, Hussain Mohd-Lokman<sup>2</sup>, Ibrahim Sulong<sup>2</sup> and Farid Dahdouh-Guebas<sup>5,6</sup>

<sup>1</sup> Vrije Universiteit Brussel -VUB, Pleinlaan 2, B-1050 Brussels, Belgium  
E-mail: [melissa.quispe.zuniga@vub.ac.be](mailto:melissa.quispe.zuniga@vub.ac.be)

<sup>2</sup> Institute of Oceanography and Environment-INOS, Higher Institution Centre of Excellence (HiCoE) in Marine Sciences, Universiti Malaysia Terengganu-UMT, 21030 Kuala Terengganu, Terengganu Daru Iman, Malaysia.

<sup>3</sup> CIRAD, UPR Bioagresseurs : Analyse et Matrise du Risque, Montpellier F-34398, France

<sup>4</sup> Institute of Forest Growth and Forest Computer Sciences, TU Dresden, PO Box 1117, 01735 Tharandt, Germany

<sup>5</sup> Laboratory of Systems Ecology and Resource Management, Department of Organism Biology, Faculty of Sciences, Université de Bruxelles-ULB, Campus de la Plaine, Boulevard du Triomphe, B-1050 Brussels, Belgium

<sup>6</sup> Laboratory of Plant Biology and Nature Management, Mangrove Management Group, Faculty of Sciences and Bio-engineering Sciences, Vrije Universiteit Brussel-VUB, Pleinlaan 2, B-150 Brussels, Belgium

Mangrove ecosystems are present in tropical coastlines and provide goods, services and economic opportunities for local communities (Barbier *et al.*, 2011). Local people can use mangrove forests for timber and fuelwood, animals for consumption (*e.g.* fish, crabs) and services (*e.g.* nursery grounds, breeding and feeding sites, and coastline protection) that mangrove forests provide (Barbier *et al.*, 2011). An excellent example of management of a mangrove forest is Matang Mangrove Forest Reserve (in Malaysia) that has been managed since 1908 by Perak Forestry Department for the production of poles and fuelwood (Chong, 2006). The need of a model that includes socio-economic aspects as well as forest growth in Matang is important for shaping future decisions, ensuring sustainable income sources for local people, and improving the silvicultural management practices (Fontalvo-Herazo *et al.*, 2011). The studies related to this reserve have focused on ecological or economic aspects; however, currently there is no research that has considered the economic aspects in close relation to ecologic aspects. Therefore, the aim of this master thesis is to build an ecologic-economic model that includes labor cost for different silviculture related activities, wood prices of different qualities, benefits and costs of natural/silvicultural stands, and possibly hidden environmental benefits, and that can predict future sustainability of wood production under different scenarios of ecologic or human impact.

This on-going study is divided in three parts; the first part is the development of an individual-based model in NetLogo v5.0.4. program, using ODD (Overview, Design concepts and Details) Protocol (Railsback and Grimm, 2012) for the purpose of making predictions, which are based on the conditions that are influenced by potential economic factors that can influence mangrove forest density. The second part consists of a field-component that will take place in February (2014), in Matang Mangrove Forest Reserve (Perak, Malaysia); this part consists of an economic survey involving the people who are part of the mangrove wood trade. For this reason the economic survey is divided in four groups: consumers, harvesters, wholesalers, and formal actors (related to Forestry Department). The third part will consist of the calibration of the developed model with the results of the economic survey and the ecological results (forest density in Matang Mangrove Forest Reserve) that were made by Goessens (2011) in Matang.

Finally, we hope that the ecologic-economic model will enable us to determine the possible family incomes in dependence of changes in mangrove forest growth and economic circumstances. The predictions can be used to improve current and future management practices during the decision making, protecting mangrove ecosystems and the livelihood of local people who depend on the mangrove forest.

### References

Barbier E.B., S.D. Hacker, C. Kennedy, E.W. Koch, A.C. Stier and B.R. Silliman. 2011. The value of estuarine and coastal ecosystem services. *Ecological Monographs* 81(2):169-193.

- Chong V.C. 2006. Sustainable utilization and management of Mangrove ecosystems of Malaysia. *Aquatic Ecosystem Health & Management* 9(2):249-260.
- Fontalvo-Herazo M.L., C. Piou, J. Vogt, U. Saint-Paul and U. Berger. 2011. Simulating harvesting scenarios towards the sustainable use of mangrove forest plantations. *Wetlands Ecology and Management* 19(5):397-407.
- Goessens A. 2011. Floral diversity and distribution in the mangroves t Matang, West Peninsular Malaysia, after a century of sustainable management. Master Thesis. Université Libre de Bruxelles, 122pp.
- Railsback S.F. and V. Grimm. 2012. *Agent-based and individual-based modeling: a practical introduction*. Princeton University Press, 329pp.